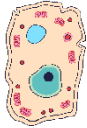# Cells

Cytology = the study of cells

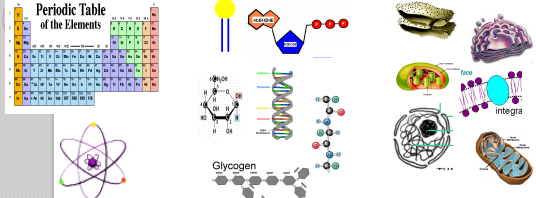**What Are the Main Characteristics of organisms?**

1. Made of **CELLS**
2. Require **ENERGY** (food)
3. **REPRODUCE** (species)
4. Maintain **HOMEOSTASIS**
5. **ORGANIZED**
6. **RESPOND** to environment
7. **GROW** and **DEVELOP**
8. **EXCHANGE** materials with surroundings (water, wastes, gases)
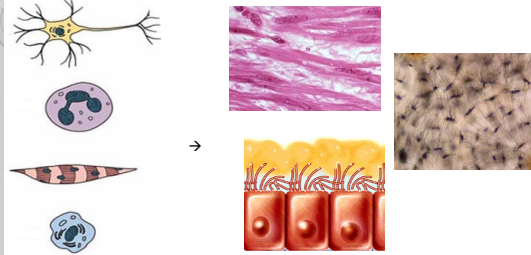

Organization Levels of Life

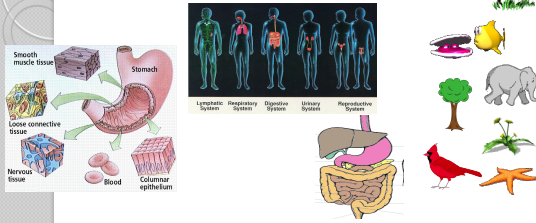*Atoms to Organisms*

Nonliving Levels

ATOMS →　　　MOLECULES　→　　　ORGANELLES

Living Levels

CELLS – life starts here　→

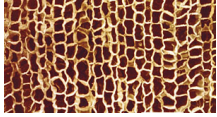TISSUES – Similar cells working together

---

More Living Levels

ORGANS　　→　ORGAN SYSTEMS　→　ORGANISM

Different tissues working together

Different organs working together
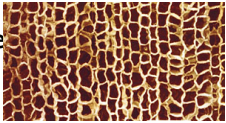
History of Cells

First to View Cells

- **In 1665, Robert Hooke used a microscope to examine a thin slice of cork (dead plant cell walls)**
- **What he saw looked like small boxes**

8

First to View Cells

- **Hooke is responsible for naming cells**
- **Hooke called them "CELLS" because they looked like the small rooms that monks lived in called Cells**

copyright cmassengale   9

Anton van Leeuwenhoek

- **In 1673, Leeuwenhoek (a Dutch microscope maker), was first to view organism (living things)**
- **Leeuwenhoek used a simple, handheld microscope to view pond water & scrapings from his teeth**

Focus Knob   Leeuwenhoek Microscope
Lens   Sample Holder   Sample Translator

10

Beginning of the Cell Theory

- **In 1838, a German botanist named Matthias Schleiden concluded that all plants were made of cells**
- **Schleiden is a cofounder of the cell theory**

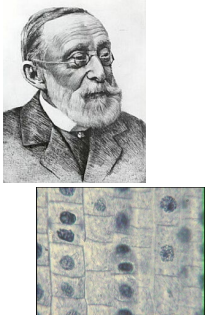copyright cmassengale   11

Beginning of the Cell Theory

- **In 1839, a German zoologist named Theodore Schwann concluded that all animals were made of cells**
- **Schwann also cofounded the cell theory**
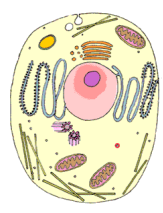
12

Beginning of the Cell Theory

- In 1855, a German medical doctor named **Rudolph Virchow** observed, under the microscope, **cells dividing**
- He reasoned that **all cells come from other pre-existing cells** by cell division

13

CELL THEORY

1. **All living things are made of cells**
2. **Cells are the basic unit of structure and function in an organism (basic unit of life)**
3. **Cells come from the reproduction of existing cells (cell division)**
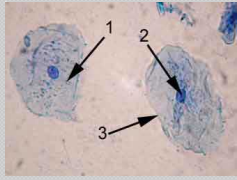
14

Number of Cells

Although ALL living things are made of cells, organisms may be:

- *Unicellular –* composed of one cell
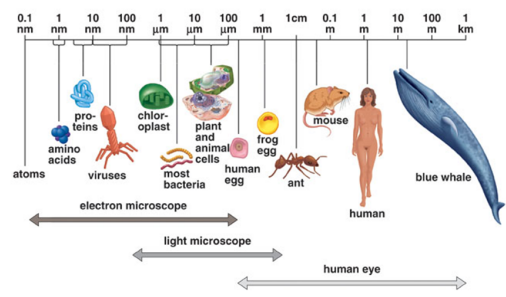- *Multicellular-* composed of many cells that may organize into tissues, etc.

15

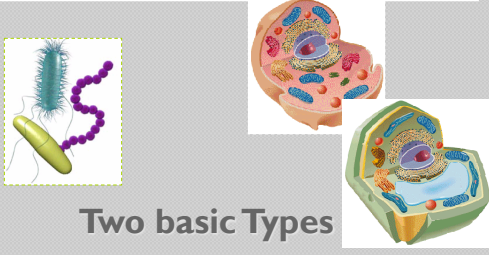| Three basic parts of a cell	Two types of cells
• 1 cytoplasm • 2 nucleus • 3 cell membrane	• Prokaryotic • Eukaryotic

he study of cells

CELL SIZE

Typical cells range from 5 – 50 micrometers (microns) in diameter
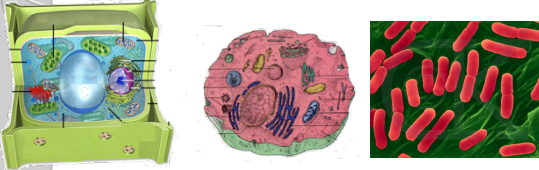
17

Prokaryotic = bacteria
No nucleus

Eukaryotic = plant and animal "true" nucleus

Two basic Types

Which Cell Type is Larger?

Plant cell **>** Animal cell **>** bacteria

19

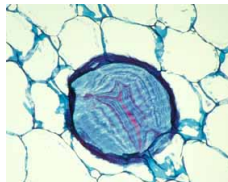---

Common Features in ALL cells:

- All cells have:
- Cell membrane
- DNA
- Cytoplasm

- Obtain energy and nutrients from their environment
- Cell function limits cell size (cell parts can not be too far away from cell membrane; nutrients/waste must enter and exit at membrane)
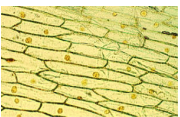
20

- **SURFACE AREA AND VOLUME**

Plasma membrane

- Surrounds cell
- Separates the contents of the cell from its environment
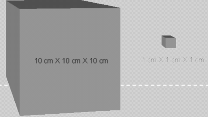- Regulates the passage of molecules into and out of the cell.

Active cells

- An actively metabolizing cell needs a large surface area.
- Cells are limited in size because larger cells have a smaller surface to volume ratio.

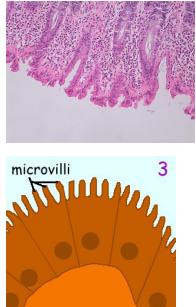
SURFACE:VOLUME

10 cm X 10 cm X 10 cm

- larger cube has more surface area and more volume but less surface area for each cubic centimeter of volume.
- For any given geometric object (cubes, spheres, etc.), smaller objects have a greater surface to volume ratio (SA:V) than larger objects of the same shape.

SA:V of Large Cube	SA:V of Small Cube

• SA = # sides x side^2
   = 6 x 10^2 = 600cm^2
 	
 • V = l x w x h
   = 10cm x 10cm x 10cm = 1000cm^3
 	
 • SA:V ratio = 600cm^2/1000cm^3
   = 0.6cm
	• SA = # sides x side^2
	   = 6 x 1^2 = 6cm^2
	
	 • V = l x w x h
	   = 1cm x 1cm x 1cm = 1cm^3
	
	 • SA:V ratio = 6cm^2/1cm^3
	   = 6cm

Most cells are very small and therefore have a high ratio of plasma membrane surface to cell volume.

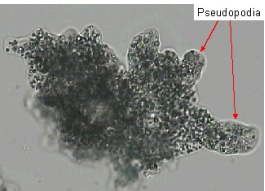10 cm X 10 cm X 10 cm   1 cm X 1 cm X 1 cm

Microvilli

• Cells that are specialized for absorption (ex: intestinal cells) have folds in the plasma membrane called **microvilli** that increase the surface area.
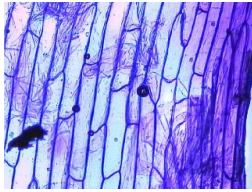
microvilli   3

Pseudopodia are temporary extensions of the plasma membrane used for movement or to engulf particles.

Found in amoebas

Pseudopodia
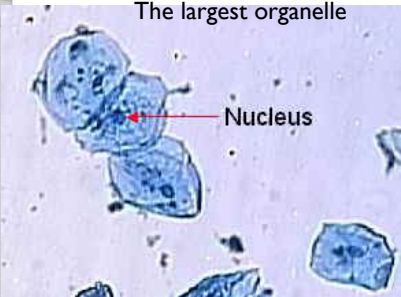
Cell Wall

• The cell wall functions to support and protect the cell.
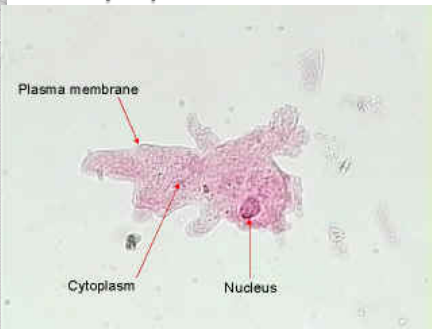• Plants have cell walls composed of <u>cellulose</u>; fungi have walls composed of <u>chitin</u>.

Onion cell walls

---

Nucleus

The largest organelle

Nucleus

Cytoplasm

Plasma membrane

Cytoplasm   Nucleus

And what they contain….

PRO VS. EU

Prokaryotic Cells

- Small, simple (no membrane-bound organelles)
- Surrounded by cell wall and cell membrane
- Lack nucleus (nucleoid region)

PRO = NO nucleus

- Single, circular, coiled chromosome (DNA) inside nucleoid region
- Cytoplasm
- Ribosome (to make proteins)
- Specialized projections on surface (cilia and flagella)

Capsule
Cell wall
Plasma membrane
Cytoplasm
Ribosomes
Plasmid
Pili
Bacterial Flagellum
Nucleoid (circular DNA)
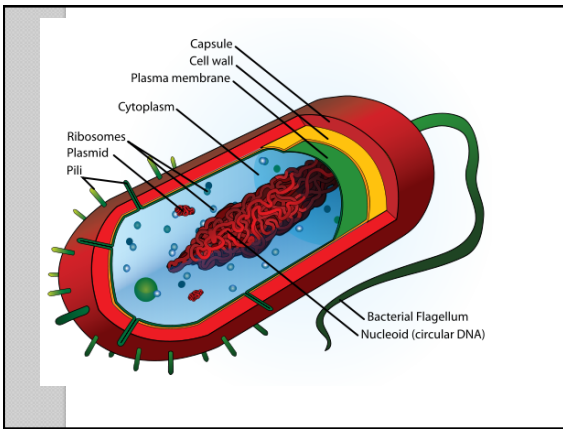
Eukaryotic Cells

- Larger, complex (contain membrane-bound organelles)
- Cytoskeleton (network of protein fibers giving shape and organization to cell)
- Has a nucleus

EU = TRUE NUCLEUS or "YOU" HAVE A NUCLEUS

- Cytoplasm
- Ribosome PLUS a whole lot more!!!
- Also has specialized structures (cilia and flagella)
- 2 types: Plant and Animal

Two Main Types of Eukaryotic Cells
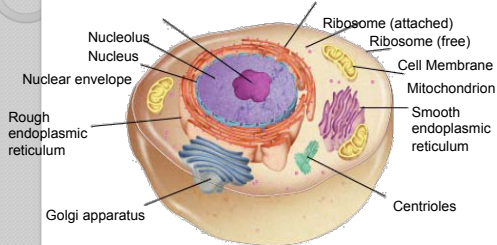
Plant Cell

Animal Cell

35

Organelles

36

What is an ORGANELLE?

- Organelle = membrane-enclosed structure performing specific functions for the cell
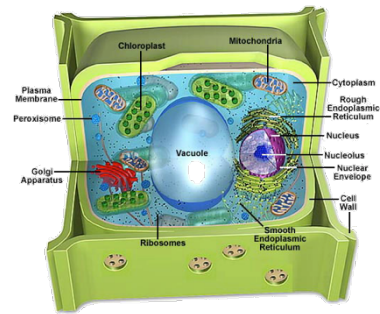
- Organs for Cells!

Organelles

- **Very small (Microscopic)**
- **Perform various functions for a cell**
- **Found in the cytoplasm**
- **May or may not be membrane-bound**
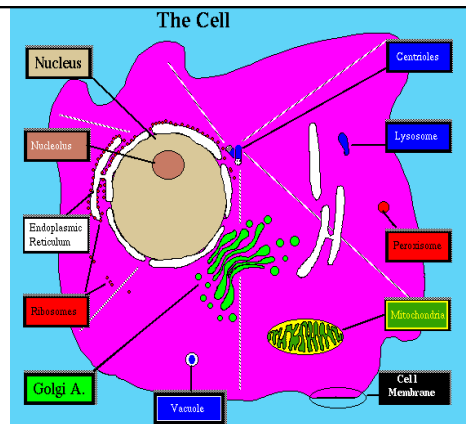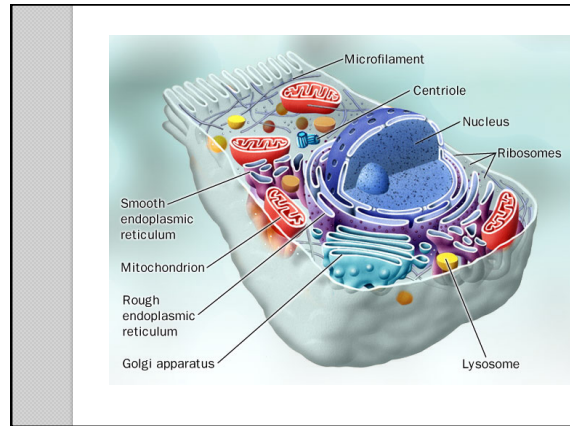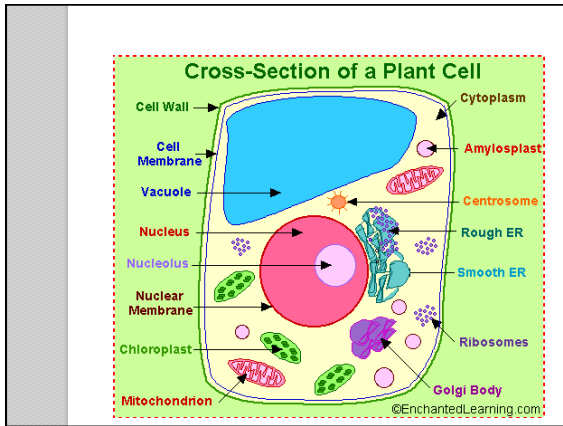
38

Animal Cell Organelles

Nucleolus
Nucleus
Nuclear envelope
Rough endoplasmic reticulum
Golgi apparatus
Ribosome (attached)
Ribosome (free)
Cell Membrane
Mitochondrion
Smooth endoplasmic reticulum
Centrioles

39

Plant Cell Organelles

Chloroplast
Mitochondria
Plasma Membrane
Peroxisome
Golgi Apparatus
Vacuole
Ribosomes
Cytoplasm
Rough Endoplasmic Reticulum
Nucleus
Nucleolus
Nuclear Envelope
Cell Wall
Smooth Endoplasmic Reticulum

40
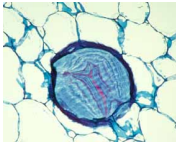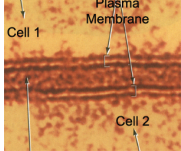
Parts of a Eukaryotic Cell

The Cell

Nucleus
Nucleolus
Endoplasmic Reticulum
Ribosomes
Golgi A.
Vacuole
Centrioles
Lysosome
Peroxisome
Mitochondria
Cell Membrane

Cross-Section of a Plant Cell
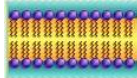
©EnchantedLearning.com

Cell Membrane

- Flexible
- Like skin surrounding the cell
- Made of lipids and proteins
- <u>Selectively permeable</u>: controls movement of materials into and out of the cell
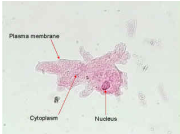

Lipids & Proteins

- <u>Lipid bilayer</u>: hydrophilic heads point outwards; hydrophobic tails point inward
- Proteins move materials (lipids) into and out of the cell:
  - <u>peripheral proteins</u>: attach to the internal & external surface
  - <u>integral proteins</u>: found within lipid bilayer
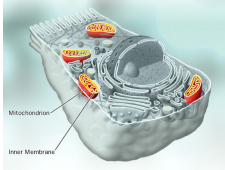
Cytoplasm

- Cytoplasm: material found between cell membrane and nucleus
- Cytosol: gelatin-like fluid organelles are bathed in

Mitochondria
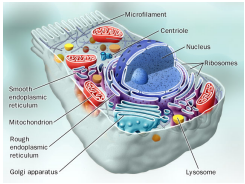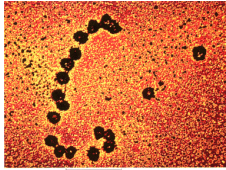
- The power plant
  - provides energy to the cell
- Chemical reactions transfer energy from organic compounds to ATP
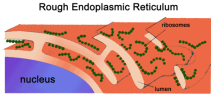- <u>Cristae</u>: internal, long folds; increase surface area so more reactions can occur
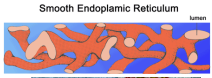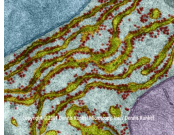
Ribosomes

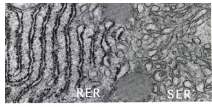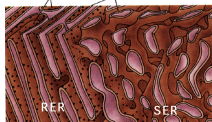- Site of protein synthesis

0.05 micrometers

Rough Endoplasmic Reticulum (RER)

- Network of tubes and sacs that serve as a highway for molecules to move along
- Lots of ribosomes on it

Rough Endoplasmic Reticulum
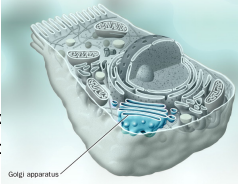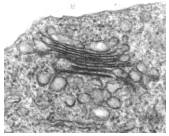
Smooth Endoplasmic Reticulum

Smooth Endoplasmic Reticulum (SER)

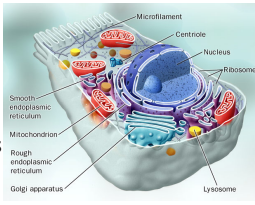- Tubes and sacs that work as the cell's highway
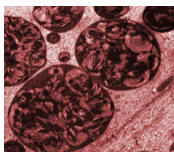- Not covered with proteins

Golgi Apparatus

- AKA Golgi Complex
- Process, package, and secrete proteins
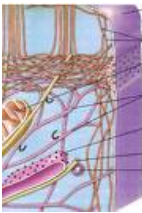- Series of flattened sacs

Lysosomes

- Small sacs
- Enzymes digest organic molecules and old organelles
- "Clean up"
- Common in animal cells, rare in plant cells

Cytoskeleton

- A network of long protein strands in the cytosol that help maintain cells shape and size
- Microfilaments: made of protein called actin; these are the smaller strands that contribute to cell movement and contraction of muscles
- Microtubules: larger, hollow tubules; include spindle fibers that assist in cell division
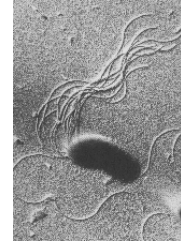
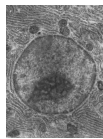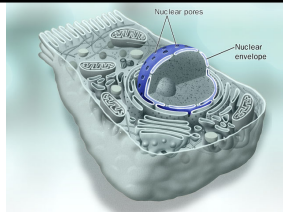## Cilia

- Small beating hairs
- Means of movement
- Many
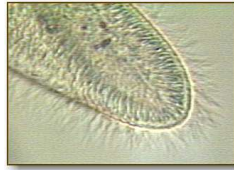
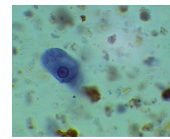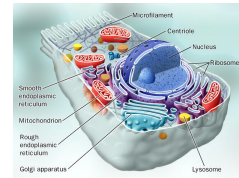## Flagella

- Whip like structure
- Means of movement
- Few

Nucleus

- Largest organelle
- Contains the cell's DNA
- Manages the cells functions
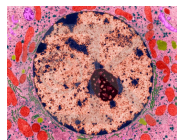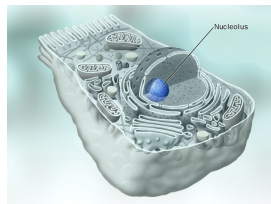- "the brain" of the cell

Nuclear membrane or envelope

- Membrane that surrounds the nucleus
- Controls movement of materials into and out of the nucleus

Nucleolus
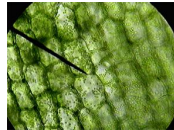
- Part of the nucleus
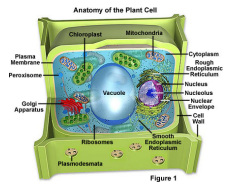- Site where ribosomes are synthesized

Plant Cells

- Cell Wall
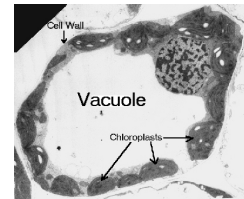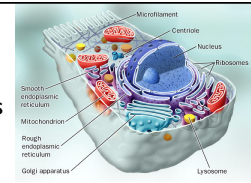- Vacuoles
- Plastids: Chloroplast

Cell wall

Anatomy of the Plant Cell

- Rigid wall around cell to provide support
- Made of cellulose
- Only in plant cells

Vacuole

- Large storage sacs
- Larger in plants than animals
- Store wastes and in plants store glucose from photosynthesis

Vacuole

Chloroplasts

Anatomy of the Plant Cell

- Only in plant cells
- Transforms sunlight into usable energy for the cell
- Chlorophyll is the green pigment that traps the sunlight